

an apathetic House, has fallen flat, while the English Act, badly drawn as it is, is arousing a great and increasing amount of interest in the country, and within the first six months is already in full swing in several districts.

But this is a digression. The recasting and improvement of the system of class subjects in Scotland is interesting not only in itself but as indicating a probable change of a similar kind in the English Code. Under these circumstances we must not fail to note the parallel change carried out in the schedule of "specific subjects." Almost the whole of the schedule which relates to science subjects—chemistry, mechanics, electricity, light and heat, physiology, botany, and physical geography—is entirely cancelled, and for the detailed syllabuses of these subjects is substituted a simple invitation to school managers to submit graduated courses in subjects not mentioned in the schedule. At first sight this seems a loss—as though the Department were moving in the direction of paying less instead of more attention to science. The alteration, however, must be read in conjunction with the reforms in class schedules and the observations on class and specific subjects in the last Report of the Scotch Education Department. Commenting on the fact that "the general development of class subjects tends to restrict the specific subjects," the Report proceeds: "this is a result not altogether to be regretted, as the influence of the class subjects is general, while that of the specific subjects is restricted to a few selected scholars."

Again, in the instructions to inspectors just issued, Mr. Craik explains one of the objects of the Department to be "to spread the beneficial results of any such higher teaching as may be given, to the whole school, instead of confining it to a few selected scholars."

It is clear, therefore, that the changes in the fourth and fifth schedules (which are probably the precursor of similar changes in the English Code) are dictated by a desire to extend class instruction in science, even if at the expense of specific subjects; in other words, to transfer natural science from its former position, as a smattering of a few special branches of physics imparted to a few pupils, to its proper place as a course of general stimulating instruction in the elements of "nature knowledge," given as an integral part of the school course to the school as a whole. More specialized science teaching can still be provided if desired in the form of specific instruction framed to suit local wants by the various school managers, or it may be given, as is already the case in many elementary schools, by means of science classes in connection with the Science and Art Department.

We cannot doubt that the Scotch Department is right in its policy, but the probable extension of class teaching under the new and more elastic *régime* suggests a doubt whether the proper way of introducing manual instruction is by means of including it among the class subjects, so long at least as the possible number of class subjects is restricted. Drawing—the only form of manual training previously recognized for boys—has already been put outside the range of class subjects. Needlework—the only other manual subject in the Code—may be taught either as a class subject or as part of the ordinary curriculum of the school. Is there not a chance that in including manual

instruction among the class subjects an unnatural rivalry may be set up between this subject and elementary science, which may restrict the spread of both? All this, however, is a matter for the future. Meanwhile we have only to congratulate the Scotch on the improvement of the conditions under which in the future their schools will be carried on, and to express the hope that England will not lag behind.

One word in conclusion. It may be wondered why in this article, dealing with scientific and technical instruction in elementary schools, so little reference is made to the Technical Instruction Act of last session, either in respect of the powers which it confers on elementary school managers, or of those which, much to the regret of many politicians, it appears to withhold.

The real fact is that we have our doubts as to the need of any general Technical Instruction Act for elementary schools, and have a suspicion that their exclusion from the late Act was in reality a blessing in disguise. Of course, if the opinion of Sir Horace Davey (and now we are glad to be able to add, of the Scotch Education Department) should be upset in the law courts, it may be necessary to rectify the anomaly by a short Act of a single clause recognizing the legality of manual instruction. But, with this possible exception, no new powers are required by School Boards, and no new rate need be imposed. Mr. Mundella, in complaining of the exclusion of elementary schools from the late Act, compared the scheme to an educational ladder with the lower rungs left out. Let him be reassured—no rung is wanting so far as legislation is concerned. As at present advised, we feel clear that the managers of a public elementary school, so long as they comply with the requirements of the Department, may teach what extra subjects they please. The rating power possessed by a School Board is limited only by the wishes of the ratepayers. What really retards the introduction of technical and manual instruction is the want of imperial grants (which may and ought to be given through changes in the Code), the want of time, the pressure of other subjects, the ignorance of the public, and the parsimony of the ratepayers. But none of these obstacles can be removed by legislation. What legislation could and probably would do, would be to restrict the present powers of School Boards by defining them; and, perhaps, even to confine the rate for technical instruction within the limit of a penny in the pound. But this can hardly be what Mr. Mundella wants.

A DICTIONARY OF APPLIED CHEMISTRY.

A Dictionary of Applied Chemistry. By T. E. Thorpe, B.Sc. (Vict.), Ph.D., F.R.S., &c. Assisted by Eminent Contributors. In Three Volumes. Vol. I. (London: Longmans and Co., 1890.)

THE first volume of the "Dictionary of Applied Chemistry," edited by Prof. Thorpe, is a welcome addition to our scientific books of reference, and forms an admirable companion to the "Dictionary of Theoretical Chemistry," the second volume of which was reviewed some weeks ago.

In the preface Prof. Thorpe points out that, as this

work has special reference to the applications of chemistry to the arts and manufactures, it deals but sparingly with the purely scientific aspects of the science, unless these have some direct and immediate bearing on the business of the technologist. How direct and how immediate such a bearing is at the present day, and how difficult, not to say impossible, it is to separate theory from practice, may be judged of by turning over the pages of this most useful volume.

Take, for example, the article on the azines, written by the most competent authority on that subject, Dr. Otto Witt, of Berlin. The untrained technologist will be completely at sea with the honeycomb of benzene rings with which he clearly explains the constitution of such well-known compounds as the safranenes, the splendid yellow dyes so ably investigated by Dr. Witt himself, whereas the manufacturer who has the theory of the subject at command is complete master of the situation. Or, again, let us turn to the next article, on the azo-colouring matters, communicated by another equally trustworthy authority, Prof. Meldola, covering 28 thickly-printed pages, in which the same necessary connection is seen. And no other example, perhaps, indicates more forcibly the enormous advance which applied chemistry has made in the last ten years, and its entire dependence upon abstract research. In proof of this, it needs only to be pointed out that the article concludes with a list of no less than 95 distinct patents on this one group of colouring matters, from March 12, 1878, to June 30, 1888, all of which are the result of original, chiefly German, research.

An examination of other important articles written by specially-qualified contributors indicates that each subject is brought up to the level of the present state of our knowledge. Let us look for a moment at the article on ammonia, contributed by Prof. Lunge, of Zurich. Here we find detailed reference to the newest forms of apparatus for the manufacture of ammonium salts, illustrated by excellent woodcuts of the Feldmann-still. Again, turning to the article on chlorine, we have to note the same completeness and technical grasp of the questions discussed. Thus, on p. 526, we find the method patented so long ago as 1866 by Mr. Brock, of Widnes, and now for the first time coming into general use, which has for its object the treatment of the exit gases from the bleaching-powder chambers by means of a dry lime-sprinkler, this not only removing a serious nuisance in the manufacture, but also recovering chlorine otherwise wasted.

Prof. Hummel, of Leeds, contributes an excellent article on bleaching; and here again we see that the newest processes are fully described, *e.g.* on p. 323 the Mather-Thompson bleaching process is fully noticed, and the electrical bleaching process of Hermite likewise referred to. As regards this latter, the conclusion arrived at is that now generally admitted by practical authorities, viz. that electrolytic bleaching cannot reasonably be expected to replace bleaching-powder at a price of £7 per ton.

One of the most valuable articles in the book is written by Mr. John Heron on brewing, in which he not only describes the most modern forms of brewing plant and processes, but gives a clear statement of the important researches of Pasteur and Hansen on the alcoholic ferments.

As we all know, it was Pasteur who first directed attention to those other forms of *Saccharomyces* known as "wild" yeasts in fermenting yeasts and beer; but it is not so commonly understood that it was Hansen who taught us how to introduce into the liquid a seed yeast really free from "wild" forms. Since 1883 carefully selected types of yeast from pure cultures, according to Hansen's researches, have been introduced into Denmark, Norway, and Bavaria, with the most satisfactory results, whilst in England nothing of the kind has yet been done, although, at Burton several experiments have been made in this direction. Sufficient has already been done to show that several varieties of *Saccharomyces cerevisiæ* can be separated, which, however, do not differ morphologically, but may be distinguished from each other, inasmuch as they give entirely different results, both as to flavour brightness, attenuation of the beer, and to the mode of separation of the yeast. The proportion of these different varieties in various breweries seems to remain constant, and to give the peculiar flavour and appearance which the various fermented liquors possess.

Another article is that by Prof. Noel Hartley on cements, a subject which though of great importance is not usually considered of great chemical interest, but it has been made so by the writer. He points out the fact, certainly not known to the majority of chemists, that we owe to Lavoisier the first explanation of the phenomena of the baking and hardening of plaster of Paris. At so early an age as 21, he published a short note in the *Comptes rendus* of February 17, 1765, in which he showed that water is removed from the gypsum in two stages, that the first three-quarters of the combined water must be removed in order that the plaster shall afterwards set, but that if the whole of the combined water be removed, the gypsum becomes overburnt and loses its value as plaster.

It is probable that this volume will have even a larger sale than that of the corresponding "Dictionary of Pure Chemistry," and, as with that important work, so with this, the public may well be congratulated on possessing such a valuable book of reference so creditable to all concerned in its production. H. E. ROSCOE.

OATES'S ORNITHOLOGY OF INDIA.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by W. T. Blanford. *Birds.* Vol. I. By Eugene W. Oates. Pp. i.—xx., 1—556. (London: Taylor and Francis, 1889.)

The Nests and Eggs of Indian Birds. By Allan O. Hume, C.B. Second Edition. Edited by E. W. Oates. Vol. I. Pp. i.—xii., 1—397. (London: R. H. Porter, 1889.)

THE two volumes on the birds of India, which Mr. Oates has recently published, will supply a much needed want. The period of twenty-six years which has elapsed since the publication of Jerdon's "Birds of India" has been prolific in ornithological work, to such an extent that a new adjustment of the scattered details which had accumulated since that time had become an